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(54) IMPROVEMENTS IN OR RELATING TO LIQUID EVAPORATORS

(71) I, ALBERT GENTIL, a citizen of the Republic of France, of 19, rue de la Varenne, Saint-Maur, France, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an apparatus for evaporating liquids and more particularly, although not exclusively to an apparatus for evaporating formalin (formaldehyde) at a constant rate inside a room which has to be disinfected.

In accordance with a preferred embodiment, the apparatus according to the invention is also designed to evaporate aqueous ammonia solution following on a room treatment with formalin; the vapours of ammonia being destined to neutralize the odour of the formaldehyde.

It is already known to treat closed rooms to be disinfected by fumigating with trioxymethylene, which is the trimer of formic aldehyde (formaldehyde) and which is liberated by heating dry formaldehyde. This known process has the drawback that on the one hand the released dry product does not develop its full disinfection power except in the present of water-vapour, and on the other hand the dissipated aerosol particles are far too large for a deep penetration of the vapours, which moreover leads to a rapid precipitation of the particles.

It is also known to volatilize formalin solutions by heating for disinfection purposes. According to the known processes, evaporation is, however, not performed in a continuous, regular and uniform manner and polymerization of the formaldehyde may occur. An operator entering the fumigated room will be inconvenienced by the fumes and vapours of formol and/or ammonia still present in the room.

It is a primary object of the present invention to provide an apparatus for dissipating vapour by means of which the disadvantages of the known procedures mentioned above are overcome or substantially reduced.

According to the invention there is provided an apparatus for permitting the evaporation of liquids, including at least one sealable container arranged to contain liquid to be evaporated, a pipe extending from the container having a bevel cut end, an evaporation vessel mounted for receiving the liquid in the container via the pipe and absorbent elements mounted in the evaporation vessel so as to absorb liquid in the vessel, wherein the bevel cut end of the pipe and the depth of immersion of the pipe in the evaporation vessel serve to maintain the level of liquid in the vessel and wherein the absorbent elements serve to control the rate of evaporation of the liquid.

In a preferred form of the invention such apparatus includes a first container arranged to receive an aqueous formalin solution to be vaporized for disinfection purposes, a second container arranged to receive an aqueous ammonia solution to be vaporized for neutralising the formalin, said first and second containers each being provided with a pipe having a bevel-cut end immersed in an evaporation vessel and a valve associated with each container for admitting in sequence the flow of liquid from the first and second containers into the respective pipes for evaporating successively the formalin solution and the ammonia solution by means of asborbent elements mounted partially in the respective vessel.

Constructional embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a schematical view of an apparatus for evaporating formalin and ammonia according to the invention, said apparatus operating entirely automatically and being adapted for disinfecting a living room, hospital ward or the like.

Figure 2 shows the apparatus according

to the invention mounted in a heating and/or ventilating duct.

Figure 3 is a view of a mobile unit of an apparatus according to the invention.

The apparatus according to Figure 1 comprises a formalin container 1 with a sealable filling socket 2. The flow or not out of the container 1 of an aqueous formalin solution through a pipe 4 to an evaporating vessel 5 is controlled by an electric magnetic valve 3. The vessel 5 contains absorbent pads or elements 6 acting by capillary attraction. The lower end 7 of the pipe 4 is cut on the skew. By varying the angle of the cut and the depth of insertion of the pipe into the vessel 5, the level of the formalin in the vessel 5 can be controlled according to the rate of evaporation from the pads 6 in order to maintain the correct rate of absorption by the pads. Thus, the vessel will contain only the amount of liquid required for complete impregnation of the absorbent pads, refilling of the vessel 5 being maintained according to the rate of evaporation. A blower 8 incorporates an electric resistance heater 9 at its delivery section, and thus blows hot air to enhance evaporation of the liquid. A programme controller 10 is connected through electric conductors 11, 12, 13 to the electro magnetic valve 3, the resistor 9, and the blower 8 respectively. A second container 14 for the ammonia solution comprises a sealable opening 15, a valve 16 and a pipe 17. A blower 18 with an electric resistance heater 19 promotes the evaporation of the liquid in the absorbent pads or elements 21 of the container 20. A second programme controller 22 is connected by means of the electric conductors 23, 24, 25 to the devices 16, 18 and 19 respectively.

During operation, the container 1 is filled with a 40% formalin solution with a capacity of about 20 ml per meter of the volume of the room or casing to be treated and the programme controller 10 set to the required treatment period.

As a general rule periods of up to 6 hours are required, but longer periods of up to 24 hours may be necessary to destroy certain viruses. The ammonia solution is filled into the container 14 with a capacity of about 10 ml per cublic meter room volume, and the programme controller 22 set to the required neutralizing time.

The apparatus is started by means of a switch actuating the programme controller 10 which opens the valve 3, starts the blower 8, and energizes the heating resistance 9. Air heated to about 100°C is blown against the absorbent pads 6. This procedure allows the evaporation of an aqueous solution of formalin at a regular and constant rate.

At the end of the prescribed period, the programme controller 10 closes the valve 3 and cuts out the blower 8 and heater 9. Thereupon the programme controller 22 opens the valve 16 and energizes the blower 18 and heating resistance 19 for the prescribed period of time.

By changing the elements 6 and 21, e.g. by increasing the number of absorbent pads or the surface of these pads, it is possible to regulate the rate of evaporation required by the operating conditions. Care must be taken to maintain a sufficient concentration of vapours at the highest located point in the room being treated. For very large closed spaces the apparatus may be mounted on a turntable.

The above described apparatus may, of course, be used for evaporating other solutions besides formalin and ammonia, which are only mentioned as possible examples.

In order to obtain a more effective disinfection of closed spaces it is advantageous to preheat these spaces during treatment to about 30°C. This not only yields an excellent efficiency of the formalin vapours, but also reduces the quantity of precipitates which may deposite on cold parts of the room, such as window glazing, and X-ray screens.

For this purpose a prehcater can be incorporated in the apparatus shown in Figure 1 comprising a turboblower 26 for recirculating air preheated by an electric resistance 27 with a programme controller 28 controlling the heating according to a preset programme depending on the room temperature.

It has been observed that, during the preheating period, the ammonia solution and formalin contained in the receivers 1 and 14 develop a fairly high vapour pressure. Due to this high vapour pressure, the formalin or the ammonia solution respectively squirt out at the lower ends of the pipes 4 and 7 respectively, at the moment the programme controller 10 and 22 respectively open the electro magnetic valves 3 and 16 respectively, and the liquid overflows the vessels 5 or 20 respectively.

To prevent this overflowing, the receivers 1 and 14 comprise at their upper part a pipe 29 or 30 respectively which connect the containers 1 and 14 to the pipes 4 and 17 respectively at a point located between the electro magnetic control valves and the lower ends of the pipes 4 and 17. A permanent pressure relief is thus obtained and no vapour pressure builds up in the containers. The liquid levels remain stable precisely at the level fixed by the angle of the cut on the pipes supplying the vessels 5 and 20.

The above described apparatus may be used to blow gaseous formalin and ammonia, e.g., into ventilation or air conditioning ducts or, as already mentioned, into chambers or closed rooms for disinfecting these housings and various objects included therein. The apparatus according to the invention may

also be incorporated into shafts and ducts of forced ventilation systems, as has been illustrated in Figure 2, wherein an evaporator 40 has been mounted into a such a duct 41. The apparatus shown in Figure 2 comprises one or more elements 42 similar to the elements 6 and 21 described above with reference to Figure 1. Movable flaps 43 and 43^1 arranged within the duct 41 are controlled by movable arms or levers 44, 44^1, which on their turn are displaced by means of an external screw 45 and a spindle 46. Screws 48, 48^1 allow the removal of inspection trap doors 47 and 47^1 respectively giving access to the evaporator elements 42 and the liquid supply containers 49.

A mobile unit constructed in accordance with the invention as described with reference to Figure 1 has been shown in Figure 3. The unit shown in Figure 3 can easily be moved within a room or closed space to be treated, that is more particularly, to be disinfected with formalin.

The unit comprises mainly an evaporator 50 shown in Figure 3 with its undercarriage, which is supported on four rollers 51 to facilitate its moving within the closed space. Two refill sockets 53 and 54 are shown at the upper part of evaporator for refilling the formalin and ammonia into their respective containers. Devices 55a, 55b and 55c represent the different programme controllers. The apparatus is actuated either with or without preheating by means of the switch knob 56.

Reference numerals 57 and 58 indicate the outlets of vaporized formalin and ammonia respectively. Outlets 57 and 58 are provided with directional baffles which are preferably adjustable to direct the gas flows upwardly.

The preheated air is exhausted in a similar way from outlet 59 which is also provided with a number of baffles to direct the flow.

In order to reduce precipitation of reaction products of formalin and ammonia, the apparatus designated with reference numeral 60 can be associated with the evaporator according to the invention. Apparatus 60 is also mounted on rollers 65 and is electrically connected to evaporator 50. Actuation of apparatus 60 is controlled by means of a time switch and operates for a predetermined period of time after the formalin treatment has been completed but before the ammonia treatment has been started. The air within the closed room which is activated with formalin is aspirated by a fan 61, enters the apparatus as indicated by arrows 62 and passes through a bed or layer 63 of activated carbon or any other material capable of binding the formalin.

After having actuated the fan 61 for sufficiently long time, only a very small quantity of ammonia will be required for neutralization, since the greater part of the formalin will already have been adsorbed in the element 63.

It may be worthy of note that the apparatus according to the invention can be mounted, if required for special applications, within an hermetically enclosed space either having or not an exhaust for discharging the gases to the atmosphere.

WHAT I CLAIM IS:—

1. An apparatus for permitting the evaporation of liquids, including at least one sealable container arranged to contain liquid to be evaporated, a pipe extending from the container having a bevel cut end, an evaporation vessel mounted for receiving the liquid in the container via the pipe and absorbent elements mounted in the evaporation vessel so as to absorb liquid in the vessel, wherein the bevel cut end of the pipe and the depth of immersion of the pipe in the evaporation vessel serve to maintain the level of liquid in the vessel and wherein the absorbent elements serve to control the rate of evaporation of the liquid.

2. An apparatus as claimed in claim 1, including a first container arranged to receive an aqueous formalin solution to be vaporized for disinfection purposes, a second container arranged to receive an aqueous ammonia solution to be vaporized for neutralising the formalin, said first and second containers each being provided with a pipe having a bevel-cut end immersed in an evaporation vessel and a valve associated with each container for admitting in sequence the flow of liquid from the first and second containers into the respective pipes for evaporating successively the formalin solution and the ammonia solution by means of absorbent elements mounted partially in the respective vessel.

3. An apparatus as claimed in claim 2, wherein each container is associated with an electric heater, a blower located adjacent the heater for producing hot air arranged to be applied to the absorbent elements of the respective evaporation vessel and a programme controller for controlling the operation of the valve associated with the respective container and actuating the blower.

4. An apparatus as claimed in claim 1, 2 or 3, including means for mounting said apparatus within a heating and/or ventilating duct.

5. An apparatus as claimed in claim 1, 2 or 3, including means for assembling said apparatus as a mobile unit.

6. An apparatus as claimed in claim 5, including a third blower associated with an electrical heating resistance for raising the temperature of the room or enclosed space to be disinfected and a third programme controller for controlling the operation of the third blower.

7. An apparatus as claimed in claim 5 or 6, comprising outlet openings for said air or vaporized products and directional baffles which are adjustable to direct the flow of air or gases towards the ceiling of a closed room to be disinfected.

8. An apparatus as claimed in any one of the preceding claims, including a device operable within the time interval after formalin evaporation has been terminated and before ammonia evaporation has been started, to aspirate formalin saturated air through a layer of activated carbon or any other material capable of binding formalin vapours.

9. An apparatus as claimed in any one of the preceding claims, including pressure equalizing conduits between the upper part of the at least one container and the outlet pipe of the container.

10. An apparatus substantially as hereinbefore described with reference to and as illustrated in Figs. 1, 2 or 3 of the accompanying drawings.

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1350301 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

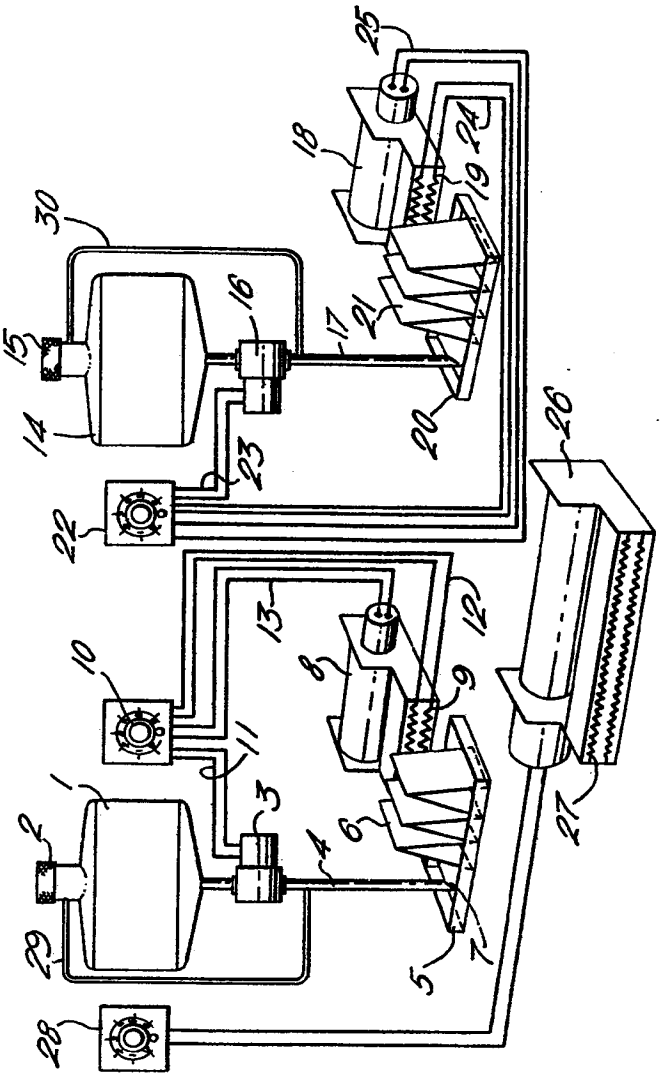
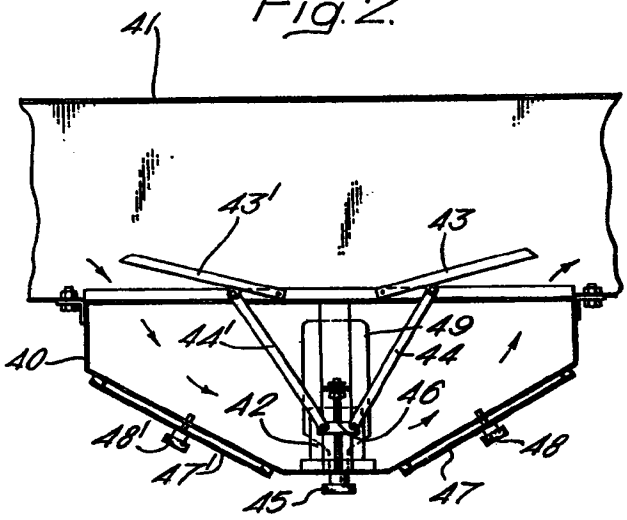


Fig.1.

Fig. 2.



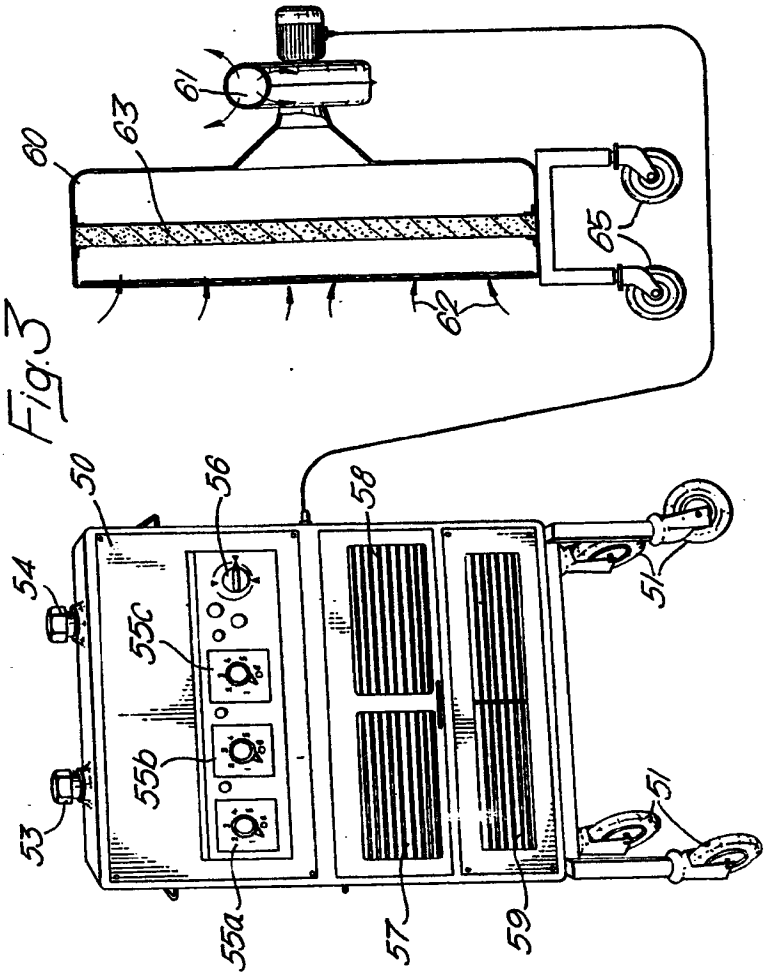


Fig.3